



United States Department of the Interior  
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:  
Post Office Box 25486  
Denver Federal Center  
Denver, Colorado 80226

STREET LOCATION:  
134 Union Blvd.  
Lakewood, Colorado 80228

IN REPLY REFER TO:

WR:

JUN 15 1983

MEMORANDUM

To: Project Leader, Medicine Lake NWR,  
Region 6

From: *Arline* Refuge Supervisor, MT & WY,  
Wildlife Resources, Region 6

Subject: Water Management Plan

Your subject plan came through with flying colors! Congratulations for a job well done.

Engineering's response to your Water Management Plan is attached. Please respond to Engineering questions as soon as possible.

Attachment

*/cc:* Engineering w/plan

*Robert C. Brown*

USFWS

63 JUN 16 P 3:04

RECEIVED IN  
ENGINEERING

Initial	Date
GR	6/9/83
W	6/9/83
W	6/9/83
GR	6/9/83

FR/1  
WR 1

JUN 10 1983

MEMORANDUM

To: AWR: (Barney Shrank)  
From: Regional Hydrologist, Region 6  
Subject: Annual Water Use Report and Management Plan (Medicine Lake NWR)

The report has been reviewed and was found to be an outstanding example that could serve as the standard against which all plans are measured. The effort that went into preparation is greatly appreciated.

Since this plan is a permanent record on file in this office, Table I need not be repeated annually unless there are changes.

It is noted that measurement devices are required on several of the tributaries. A hydrologist will be planning a trip to the refuge for that purpose, as time allows.

Regarding the request for a Volume Gradient Table, Table II indicates that the surface acres have been calculated. Please instruct the refuge manager to forward this data to the Regional Engineering Office and the required table will be prepared there.

Since the Sheep Creek (Breezer) Dam constructed last year was not designed by this office, no contact was made with the state in regard to permits required. Did refuge personnel check on the state requirements or Dam Safety Criteria? It may be that this dam is similar to the Sayer Bay Dam requiring no state permit. Please instruct the refuge manager to advise what steps have been taken on this dam.

Again, thanks to refuge personnel for the effort expended in this report.

If there are any questions or if any further information is required, please contact the Regional Hydrologist, Robert Green, or Water Rights Specialist, Ginger Chesy, at (303) 234-3616.

/s/ ROBERT G. GREEN

Attachment

EN:GChesy:jlr: 6/8/83

Rec'd. Refuge & Wildlife APR 04 1

MEDICINE LAKE NATIONAL WILDLIFE REFUGE  
MEDICINE LAKE, MONTANA

ANNUAL WATER MANAGEMENT PLAN

1982 Water Use Data

1983 Recommendations

USFWS

3 APR 8 4:33

RECORDED IN  
ENGINEERING

UNITED STATES DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE

## MEDICINE LAKE NATIONAL WILDLIFE REFUGE

## MEDICINE LAKE, MONTANA

## ANNUAL WATER MANAGEMENT PLAN - 1983

I. RECORD OF 1982 WATER USEA. Source of Supply

Fifty inches of accumulated snow fell during the winter months providing 4.29 inches of actual precipitation. Ideal spring melt provided ample run-off to completely fill all refuge wetlands. Refuge wetlands had been extremely low following two years of drought. The total water deficit prior to run-off was 42,309 acre feet. The refuge recorded 70,125 acre feet of water inflow from tributary streams between March 1 and April 15. Water flow readings were not taken after April 15, though several drainages did continue large quantities of flow for several more weeks.

B. Type of Rights

Under the Montana Water Rights Adjudication Law, all water rights filed prior to 1973 had to be refiled before April 15, 1982. The refuge water rights were researched and filed by the water resources section of engineering in the Regional Office. A filing of 30 different water rights totaling 146,715 acre feet of water was made prior to the deadline.

The legal process now requires water courts to review all claims in Montana and issue preliminary decrees. Claimants will then have the opportunity for objections and appeals before final water decrees are issued. This very lengthy process could drag on for many years before the refuge receives the final decrees.

C. Purpose of Use

Diverted water was used for storage in impoundments, lakes and marshes. This stored water is used primarily for waterfowl habitat. The habitat provided also benefits marsh and water birds, shorebirds, gulls and terns and raptorial birds. Secondary benefits are provided to the fisheries resource and resident game.

Diverted water in excess of storage needs was permitted to circulate through the system and provide a flushing action. This flushing is very important to allow accumulated salts, resulting from evaporation, to be washed out. The previous two years allowed for no flushing.

All wells and ponds were used for wildlife, livestock, and domestic purposes.

TABLE I. NEW WATER RIGHTS FILING PREPARED FOR THE MEDICINE LAKE NATIONAL WILDLIFE REFUGE BY REGIONAL OFFICE HYDROLOGISTS. THESE FILINGS COVER ALL EXISTING REFUGE RIGHTS PLUS ADDITIONAL NEW ONES.

FILING NUMBER	USE	SOURCE	AMOUNT OF WATER RIGHT	VOLUME CLAIMED AF/YEAR
1.	Fish & Wildlife	Groundwater	*	*
		Medicine Lake		
2.	Fish & Wildlife	Big Muddy Creek	1200 cfs	65,000
		Medicine Lake		
3.	Fish & Wildlife	Big Muddy Creek	50 cfs	8,000
		Medicine Lake		
4.	Fish & Wildlife	Sheep Creek	300 cfs	7,000
		Homestead Lake		
5.	Fish & Wildlife	Sheep Creek	20 cfs	3,750
		Homestead Lake		
6.	Fish & Wildlife	Lost Creek	25 cfs	4,200
		Homestead Lake		
7.	Fish & Wildlife	Unnamed Coulees	Natural Flow	21.0
		French's Waterway		
8.	Fish & Wildlife	Unnamed Coulee	Natural Flow	16.8
		Barsness Pond		
9.	Fish & Wildlife	Unnamed Coulees	Natural Flow	9.6
		Barsness Pond East		
10.	Fish & Wildlife	Unnamed Coulees	Natural Flow	11.2
		Pond A&B Bolstad Coulee		
11.	Fish & Wildlife	Unnamed Coulees & spring	Natural Flow	88.6
		Beaver Pond		
12.	Fish & Wildlife	Unnamed Coulees & Spring	Natural Flow	24.0
		Merganser Pond	15 gpm from spring	
12.	Stockwater	Unnamed Coulees & Spring	Natural Flow	.14
		Merganser Pond-Dugout	10 gpm from spring	
13.	Fish & Wildlife	Unnamed Coulees & Spring	Natural Flow	19.6
		Reeds Ponds #2	10 gpm from spring	
13.	Stockwater	Unnamed Coulees & Spring	Natural Flow	.14
		Reed's Pond #2	10 gpm from spring	
14.	Fish & Wildlife	Unnamed Coulees & Spring	Natural Flow	.65
		Stockwater Pond #3	5 gpm from spring	
14.	Stockwater	Unnamed Coulees & Spring	Natural flow	.03
		Stockwater Pond #3	5 gpm from spring	
15.	Fish & Wildlife	Unnamed Coulees & Spring	Natural flow	.65
		Stockwater Pond #4	5 gpm from spring	
15.	Stockwater	Unnamed Coulees & Spring	Natural flow	.03
		Stockwater Pond #4	5 gpm from spring	
16.	Fish & Wildlife	Unnamed Coulees & Spring	Natural flow	.65
		Stockwater Pond #5	5 gpm from spring	
16.	Stockwater	Unnamed Coulees & Spring	Natural flow	.03
		Stockwater Pond #5	5 gpm from spring	
17.	Fish & Wildlife	Sandhill Well #1	3 gpm	1.5
17.	Stockwater	Sandhill Well #1	3 gpm	.04
18.	Fish & Wildlife	Sandhill Well #3	25 gpm	10.0
18.	Fish & Wildlife	Sandhill Well #3	25 gpm	.22
19.	Fish & Wildlife	Unnamed Coulee	Natural flow	324
		Pond J		
		Section Coulee		

20.	Fish & Wildlife	Unnamed Coulee Ponds H & I Andreason's Coulee	Natural flow	80.5 (H) 92.7 (I)
21.	Fish & Wildlife	Lake Creek	100 cfs	21,400
22.	Fish & Wildlife	Deep Lake, #12, & Katy's Cottonwood Creek	100 cfs	18,200
23.	Fish & Wildlife	#10 Lake, #11 Lake Unnamed Coulee, Pond G, Stringer's Coulee	Natural Flow	10.4
24.	Fish & Wildlife	Sand Creek	75 cfs	18,200
25.	Fish & Wildlife	Gaffney Lake, Long Lake Unnamed Coulee Pond F Mrs. Henke's Coulee	Natural Flow	5.7
26.	Fish & Wildlife	Unnamed Coulee Ponds D & E Lodahl's Coulee	Natural Flow	92.4 (D) 134.6 (E)
27.	Domestic	Headquarters Well #1	300 gpm	10
28.	Domestic	Headquarters Well #2	25 gpm	10
Total				146,715.18

\* To be determined after study by USGS

#### D. Season of Use

The main season of water use is from mid-March until early December. Adequate water supplies are especially critical from mid-March to late July for waterfowl pairing and brooding habitat. Another important period of water use is mid-September to mid-November for migrational habitat for waterfowl.

The lakes and marshes are generally frozen from early December through the end of March. Adequate water levels are necessary in winter to carry over resident fish and aquatic invertebrate populations.

The main well at headquarters is used year round for domestic purposes. The secondary well at headquarters is used for irrigation of lawns and gardens from mid-May until early September.

The pumped wells in the sandhills are used for wildlife and livestock watering. This use occurs between May 1 and November 1.

#### E. Quantity Used

A total of 70,125 acre feet of water was measured entering the refuge via creek channels during spring run-off between March 1 and April 15. Readings after April 15 were not taken, though several drainages did continue large flows of water for several more weeks. This was due to the limited staff available during transfers. An estimated additional 21,000 acre feet of water entered the refuge between April 15 and June 1 giving an estimated 91,125 acre feet of water entering the refuge during 1982.

Using the deficit figure of 42,309 acre feet prior to spring run-off and the

total estimated 91,125 acre feet of diverted water, there was approximately 48,817 acre feet of water passing through the refuge system and being released into Big Muddy Creek.

The Medicine Lake outlet structure (#4 structure) was opened from June 4 through July 19 to release water down to the approved management water level. This release was calculated to be 10,912 acre feet. ✓

The Medicine Lake outlet (#4 structure) was again opened between September 3 and October 14 and a measured 10,492 acre feet of water were released into Big Muddy Creek. This 1.25 foot drop in lake level was necessary to enable the contractor on Sayer Bay dam to commence work. ✓

Between September 20 and October 12 a total of 1,033 acre feet of water was released from Homestead Lake into Big Muddy Creek. This .8 of a foot drop in the water level allowed the ice to freeze to the bottom, permitting nesting island construction on the ice. ✓

Total water loss to evaporation, transpiration, and percolation was estimated to be 4,480 acre feet.

An estimated fifteen acre feet of water was pumped from the four refuge wells.

TABLE II. MAJOR IMPOUNDMENT WATER DEFICIT, JANUARY 1, 1983

Name of Lake	Elevation Jan. 1, 1983	Operating Elevation	Elevation Difference	Acre Ft. Deficit	Surface Acres at Operational Level*
Homestead Lake	1934.92	1937.65	-2.73	3352.4	1228.0
Gaffney Lake	1944.20	1945.00	- .80	515.5	644.4
#10 Lake	1945.40	1945.80	- .40	106.4	266.0
Deep Lake	1945.40	1945.80	-1.60	159.4	99.6
Long Lake	1944.20	1945.00	- .80	55.4	69.2
#11 Lake	1952.20	1953.00	- .80	152.9	191.2
#12 Lake	1955.05	1956.00	- .95	455.2	479.2
Katy's Lake	1953.50	1954.40	- .90	280.8	312.0
Medicine Lake	1941.80	1943.02	-1.22	10241.6	8394.8
Total				15319.6	11684.4

\* Surface acres only - volume/gradient tables needed.

TABLE III. COMPARISON OF WATER DEFICIENCIES\*

Impoundment	Acre Feet of Water Needed								
	1983	1982	1981	1980	1979	1978	1977	1976	1975
Homestead Lake	3352	5993	4298	2028	4199	2648	2002	1589	2648
Gaffney's Lake	516	3022	2442	547	214	842	641	0	427
#10 Lake	106	356	266	23	23	97	131	0	89
Deep Lake	159	287	403	34	23	57	52	0	52
Long Lake	55	377	291	76	30	149	89	0	89
#11 Lake	153	402	405	288	174	462	307	250	386
#12 Lake	455	1198	729	620	286	1324	968	1785	991
Katy's Lake	281	705	661	334	183	330	484	325	588
Medicine Lake	10242	29969	23002	11921	5205	19980	9738	3862	11249
TOTAL	15319	42309	32497	15871	10337	25898	14412	7811	16519

\* Deficiencies are based on water elevations on January 1 of each year.

TABLE IV. MAJOR IMPOUNDMENT WATER DEFICI

AREA	DEFICIENCY IN AC	
	Spring 1982	F
Homestead Lake	5,993	
Gaffney Lake	3,022	
#10 Lake	356	
Deep Lake	287	
Long Lake	376	55
#11 Lake	402	153
#12 Lake	1,198	455
Katy's Lake	705	281
Medicine Lake	29,969	10,242
TOTAL DEFICIENCY	42,308	15,319

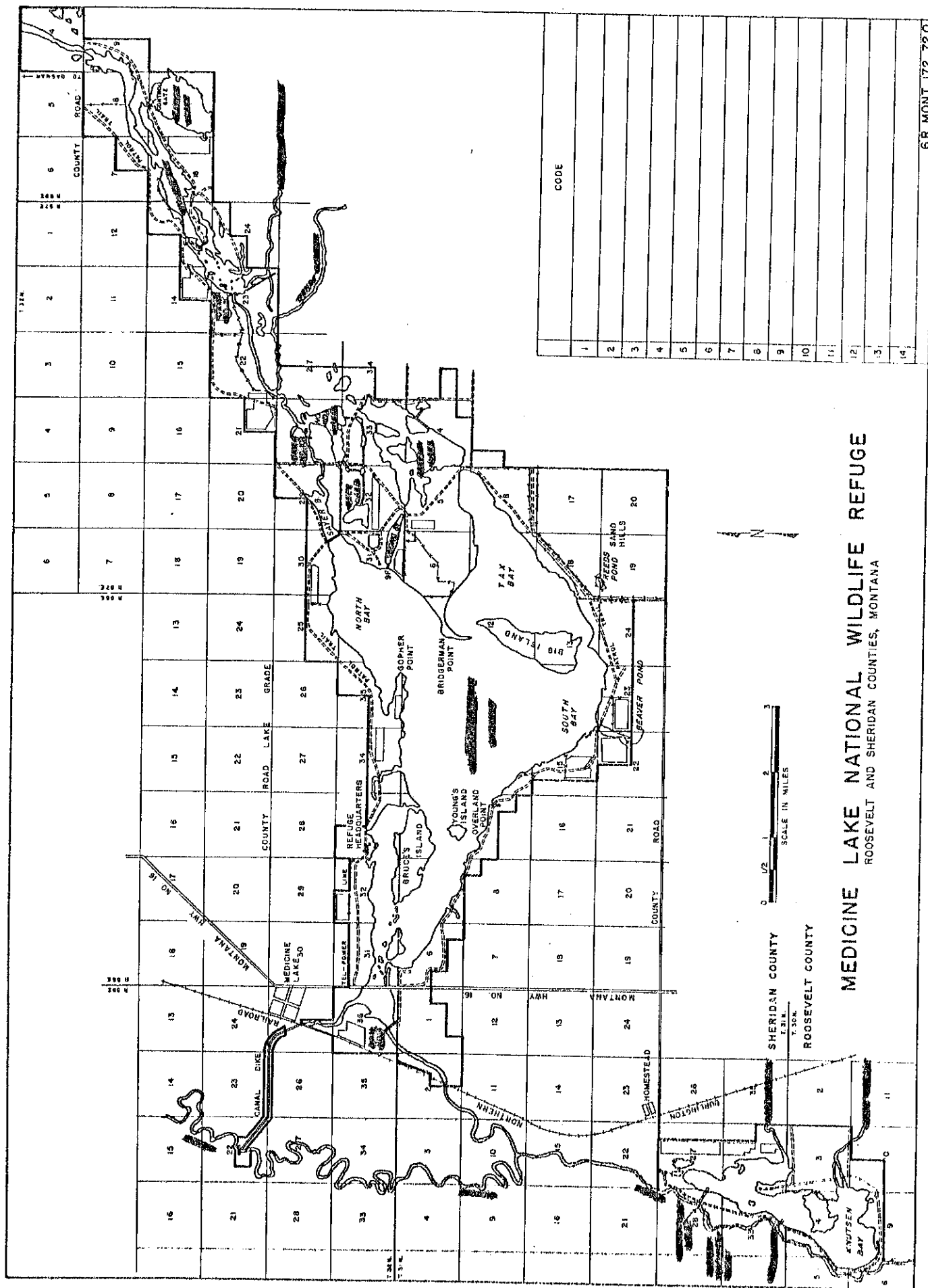
11967, 36316, 28199, 13143, 6138, 23250, 12410, 83, 82, 81, 80, 79, 78, 77

less homestead

Sand Creek  
Cottonwood Creek  
Lake Creek  
Sand Creek  
Cottonwood Creek  
Lake Creek  
Sand Creek  
Lake Creek  
Lake Creek  
Big Muddy Creek  
Lake Creek

5026, 13471





# F. Place of Use

TABLE IV compares the deficiency of each major refuge impoundment in 1981 and 1982. This table also lists the tributary streams which supplies water to each impoundment.

# G. Adequacy of Supply

Spring run-off was more than adequate to bring all wetlands up to operational levels. Adequate water was available to permit flushing of most impoundments.

TABLE V. shows the amount of water received during spring run-off from each tributary stream during 1982.

TABLE V. WATER RECEIVED PER TRIBUTARY STREAM - 1982

<u>Tributary Source</u>	<u>Acre Feet of Water Diverted</u>
Big Muddy Creek	39,930 *
Lost Creek	7,074
Sheep Creek	13,821
Sand Creek	8,947
Cottonwood Creek	11,014
Lake Creek	10,339
<hr/>	
Total Diverted	91,125 Acre Feet

\* 70,125 acre feet actually recorded up to April 15. 21,000 acre feet additional was estimated, as flows continued through May 31.

The total recorded precipitation at headquarters for 1982 was 16.06 inches which is 1.88 inches above the normal of 14.18 inches. As shown on TABLE VI, the big increase above normal precipitation came during the winter months. Mid-summer months were slightly below normal in precipitation and resulted in a slight decrease in water levels on all impoundments.

TABLE VI. ANNUAL PRECIPITATION AMOUNTS (Inches)

Month	<u>1981</u> <del>1982</del>		<u>1982</u> <del>1981</del>		Normal Precipitation
	Total Precipitation	Snowfall	Total Precipitation	Snowfall	
January	1.47	29.0	.01	.5	.43
February	.61	6.0	.08	1.0	.39
March	1.31	13.0	.30		.37
April	.90	2.0	.77		1.24
May	2.56		1.16		1.78
June	2.62		5.28		3.45
July	1.80		1.17		2.12
August	1.53		.40		1.68
September	1.57		.90		1.17
October	1.20		.65		.71
November	.01		.41	4.0	.51
December	.48	9.0	.19	3.0	.33
Total	16.06	59.0	11.32	8.5	14.18

TABLE VII. MONTHLY RECORD OF GAUGE READINGS - 1982

IMPOUNDMENT OPERATIONAL LEVEL **	Homestead Lake	Gaffney Lake	#10 Lake	Deep Lake	Long Lake	#11 Lake	#12 Lake	Katy's Lake	Medicine Lake
January	1937.65	1945.00	1945.80	1946.20	1945.00	1953.00	1956.00	1954.40	1943.02
February	1932.77	1940.31	1944.46	1943.32	1939.56	1950.90	1953.50	1952.14	1939.45
March	*	*	*	*	*	*	*	*	*
April	1934.10	*	1946.60	1946.70	*	*	*	*	1941.60
May	1937.30	*	1946.94	1946.50	1945.04	*	1957.94	1952.10	1942.60
June	*	*	*	*	*	*	*	*	*
July	1936.80	*	1946.10	*	*	1952.40	1956.50	1954.70	1944.20
August	1936.50	1945.40	1945.90	1945.85	1945.40	1952.30	1956.35	1954.60	1943.20
September	1936.00	1944.60	1945.22	1945.00	1944.70	1952.00	1955.60	1953.85	1942.85
October	1935.60	1944.30	1944.90	1944.60	1944.30	1951.70	1955.10	1953.50	1941.70
November	1934.80	1944.25	1945.25	1944.60	1944.25	1952.00	1955.05	1953.55	1941.75
December	1934.92	1944.20	1945.40	1944.60	1944.20	1952.20	1955.05	1953.50	1941.80
	*	*	*	*	*	*	*	*	*

\* Not Available

\*\* It should be noted that although these operational levels may be different than previous plans (Prior to 1980), it is because they had been recalculated in 1981, to correct MSL readings. It was found that many of the gauges were incorrectly set. The approved actual water levels remained unchanged.

#### H. Improvements to Water Facilities During 1982

The Sheep Creek Dam #2 (Breaser Dam), on the Homestead Unit, was partially completed in the winter of 1981-82. Due to the harsh winter, total completion was not accomplished. During the high spring run-off, this unripraped dike washed out. What remained after run-off was further damaged by high water and wave action.

This dike was again reconstructed in December of 1982. The riser tube was reset and spillway completed. The entire west side of the dike was ripraped. This new dam will create a 60 acre marsh.

The Sayer Bay Dam which was started in 1981 remained uncompleted at the end of 1982. High water levels in Medicine Lake and an uncooperative contractor resulted in no work being started in 1982. When completed this impoundment will create a permanent marsh, 170 acres in size.

The concrete ford crossing on the county road through Sayer Bay was completed in early June. This spillway will alleviate the reoccurring damages to the road caused by high spring run-off.

The spillways on the #4 dike on Medicine Lake were ripraped. This was required to reduce further erosion below the spillway.

#### I. Effects of Previous Years' Objectives

All major impoundments were filled with early spring run-off as planned. This adequate water supply provided ideal breeding pair and brood habitat. Total duck pairs and resulting production actually declined from the severe drought year of 1981. This decline was attributed to more available pair habitat off of the refuge during a good water year, resulting in greater dispersal of birds.

Spring run-off provided enough water flows to flush all impoundments. Water quality was greatly improved following two years of drought with no flushing. Salinity and conductivity dropped significantly in all impoundments.

As planned, Medicine Lake was held as high as possible through most of the summer. This level provided very good pairing habitat along the shoreline. This high level also maintained water in the emergent vegetation on the west side of Highway #16 and in the upper reaches of Sayer Bay. This provided secure nesting sites for over the water nesters, such as western grebes and diver ducks.

The high water levels in Medicine Lake should have provided good spawning habitat for northern pike. The levels remained high through mid-summer providing good hatching and fry development habitat.

Water levels on Medicine Lake remained high enough into late fall to provide adequate depth for over-wintering of the fisheries resource.

It was recommended to draw down Homestead Lake if a botulism outbreak occurred. Though a severe outbreak did occur in 1982, it was decided not to draw down. Water could not be released quickly enough in late July to drop the water levels

without exposing mud flats which could have worsened the problem. Water releases from Homestead Lake must be controlled to prevent flooding of access crossings on Big Muddy Creek. Downstream farmers are dependent on these crossings during haying season.

A total of 3,780 birds were picked up during an intensive botulism patrol on Homestead Lake.

Water levels in Katy's Lake, #10 Lake were kept as stable as possible through the summer months as recommended to lessen botulism losses. Botulism losses were still fairly high with 660 birds picked up in Katy's Lake and 610 birds in #10 Lake.

Aquatic vegetation stands seemed to grow quite well in most impoundments. Submerged vegetation provided excellent waterfowl food sources in #10, #11 and #12 lakes.

## 1982 SUMMARY

Water deficiency on January 1, 1982 - 42,309 A/F

Total water flow received by refuge -

Spring flow - recorded 70,125 A/F Prior to April 15

- estimated 21,000 A/F April 15 - June 1

Total - 91,125 A/F

Summer flow - None

Excess water diverted from the refuge -

Spring flow - 48,817 A/F

Medicine Lake Release 6/4-7/19 - 10,912 A/F

Medicine Lake Release 9/3-10/14-- 10,492 A/F

Homestead Release 9/20-10/12 - 1,033 A/F

71,254 A/F

Water diverted from Medicine Lake to Homestead Lake

None .

Water deficiency on December 31, 1982 15,319 A/F

Total water inflow utilized by refuge	42,309 A/F
---------------------------------------	------------

Total water lost to evaporation/seepage 4,480 A/F

## 1982 WATER FLOWS RECEIVED BY TRIBUTARY

Big Muddy Creek - 39,930 A/F

Lost Creek 7,074 A/F

Sheep Creek 13,821 A/F

Sand Creek 8,947 A/F

Lake Creek . 10,339 A/F

Cottonwood Creek 11,014 A/F

TABLE IX. 1982 - Water Chemistry Information on Tributary Streams - Spring Flow

Location	Date	Temp. ° C	Salinity Parts/1000	Conductivity Micromho/cent.	Comments
Muddy Creek	3/9/82	.5	1.0	1250	Start of flow
Muddy Creek	3/15/82	1°	.75	950	Diversion Canal
Muddy Creek	6/2/82	13°	.25	750	Following heavy rainfall
Sheep Creek	3/15/82	2°	0	290	
Cottonwood Crk	3/15/82	1°	0	290	Start of flow
Sand Creek	3/16/82	2.5°	0	290	
#10 into Gaffney	3/24/82	0°	0	335	
Lake Creek	4/8/82	2.5°	.75	900	Inlet

TABLE X. 1982 - Water Chemistry Information on Impoundments - Spring\*\*

Impoundment	Location	Temp. ° C	Salinity Parts/1000	Conductivity Micromho/Cent.	Comments
Medicine Lake	1A	19°	1.0	1520	Taken at Bruce's Island Narrows
Medicine Lake	1B	18°	.75	1400	Taken at shore by 9F
Gaffney Lake	2A	18°	1.0	1600	Taken at shore by outlet
Gaffney Lake	2B	16°	1.0	1500	Taken at shore by island canal.
#10 Lake	3	18°	.75	3500	Taken at shore near outlet leading to Gaffney
Deep Lake	4	18°	1.5	2500	Taken at shoreline at north bank
#12 Lake	5	*	*	*	
Katy's Lake	6	*	*	*	
#11 Lake	7	*	*	*	
Homestead Lake	8A	19°	1.25	1700	Taken in canal between north lakes
Homestead Lake	8B	18°	.75	1300	Taken at shore in Lost Creek Bay

\* Not taken

\*\* Readings taken on June 6, 1982 following run-off from tributary streams.



TABLE XI. 1982 - Water Chemistry Information on Impoundments - Fall\*

Impoundments	Location	Temp 'C	Salinity Parts/1000	Conductivity Micromho/cent.	Comments
Medicine Lake	1A	0°	1.0	1200	Taken in center of Bruce Island Narrows
Medicine Lake	1B	1°	1.0	1200	Taken 50 yds. out from
Gaffney Lake	2A	.5°	1.0	1300	Taken 100 yds out from end of outlet
Gaffney Lake	2B	1.5°	1.25	1350	Taken 100 yards out from end of island canal
#10 Lake	3	2.5°	1.5	1700	Taken 100 yds out from end of outlet to Gaffney
Deep Lake	4	1°	2.0	2125	Taken 100 ft. out from north bank
#12 Lake	5	4°	.75	900	Taken 100 ft. out from #12 dam
Katy's Lake	6	3.5°	3.0	3300	Taken 100 yds. out from structure
#11 Lake	7	3°	1.75	2000	Taken 100 ft below #12 dam
Homestead Lake	8A	2.5°	1.25	1600	Taken in canal between north lakes
Homestead Lake	8B	2.5°	1.5	1750	Taken 100 yds. into Lost Creek Bay

\* Readings taken on November 15, 1982 through 3" of ice.

## II. Recommendations and Objectives For Water Management in 1983

### A. General recommendations for all wetlands on the refuge are as follows:

1. Fill all impoundments as early as possible to insure retaining all available flow of spring run-off.
2. Fill all upper impoundments with waters from Lake Creek, Sand Creek, and Cottonwood Creeks before allowing these waters to enter Medicine Lake.
3. Provide for as much flushing action as possible with available spring and summer run-off. This will improve water qualities by reducing salinity.
4. Continue to collect water quality information by taking salinity conductivity readings of all major water flows entering or being discharged from the refuge. Spring and late fall readings should be collected, as in the past, for all major impoundments. The collection of this data will document any changes in water quality occurring over many years.
5. TABLE VIII shows the priority of water use on the refuge. Priority 1 impoundments should be filled and maintained before Priority 2 impoundments.

TABLE VIII. PROPOSED WATER USE PRIORITY

Unit	Purpose	Priority
#12 Lake	Nesting, brooding, storage, fish rearing	1
Katy's Lake	Nesting, brooding, storage	1
#11 Lake	Nesting, brooding, storage	1
#10 Lake	Nesting, brooding, storage	1
Gaffney Lake	Nesting, brooding, storage, fish rearing	2
Deep Lake	Nesting, brooding, storage	1
Long Lake	Nesting, brooding, storage	2
Sayer Bay	Nesting, brooding	1
Medicine Lake	Nesting, brooding, storage, fish rearing	2
Homestead Lake	Nesting, brooding, storage	1
Sheep Creek	Nesting, brooding	1
Breaser Dam	Nesting, brooding	1

### B. Specific recommendations and objectives for each impoundment on the refuge in 1983.

1. Medicine Lake: Mid-winter water level is 1.22 feet below the operational level of 1943.02. This will require about 10,242 acre feet of water. It is recommended to divert all available spring run-off from Big Muddy Creek into Medicine Lake. If run-off exceeds the 10,242 acre feet required, the #4 structure should be opened to release water back into Big Muddy

Creek. Due to construction work scheduled to start in early summer on the Sayer Bay dam, it is recommended not to exceed the 1943.02 elevation. The ideal level should be 1942.0 MSL by July 1. At this level coffer dams may still be required for construction on this site.

If flows entering the Homestead Lake are not sufficient to fill the lake, then water from Medicine Lake shall be released to provide what is required at Homestead.

By holding Medicine Lake at or near the 1943.02 elevation in the spring the following objectives should be met:

- a. Waterfowl breeding pair habitat will be adequate. Water levels in emergent vegetation will provide nesting locations for over the water nesters including waterfowl, grebes, and black-crowned night herons.
  - b. Natural nesting islands will be secure for geese, colonial nesting pelicans, cormorants, and great blue herons.
  - c. Due to evaporation and seepage loss, late summer water levels will be lower than desirable, but will still provide adequate fall migrational waterfowl habitat.
  - d. This 1943.02 elevation will provide water levels in emergent vegetation in Sayer Bay and the west end of the lake for early spring northern pike spawning sites. After normal summer water loss, winter water levels should remain adequate for over-wintering fish.
  - e. Erosion of islands and shorelines from wave action will be minimized.
  - f. Heavy silt laden waters of Big Muddy Creek following heavy summer thunder storms will be kept from entering Medicine Lake using the new #1 structure on the diversion canal. This will alleviate sediment deposits on the west end of Medicine Lake. Medicine Lake water levels are high enough this year that the need for this silt laden waters will not be required.
2. Homestead Lake: This impoundment is 2.73 feet below its operational level of 1937.65 elevation and will require about 3,352 acre feet to fill the lake. It is recommended to divert all available flows of Sheep Creek, Lost Creek, and Big Muddy Creek into this impoundment. If adequate flow is available, flushing should be accomplished by diverting and then releasing water through the #6 water control structure. If flows are inadequate to reach the operation level, then water should be released from Medicine Lake to meet this need.

Objectives to be met in 1983:

- a. Waterfowl breeding pair habitat will be optimum at spring operational level.
- b. Over water nesting sites in emergent vegetation for waterfowl,

grebes, and black-crowned night herons will be optimum at spring operational levels.

- c. Constructed nesting islands will provide secure nesting sites for geese and other waterfowl at spring operational levels.
  - d. Aquatic vegetation should flourish at spring operational levels in this relatively shallow impoundment.
  - e. To reduce the hazard and severity of avian botulism, the lake level will be drawn down beginning in late June. Volume of water release must be controlled to prevent flooding the access crossing to BIA hay fields downstream. The water level will be at 1936.0 elevation by July 1 and further reduced to an elevation of 1934.0 by August 1. At this level, water will be removed from the emergent shoreline vegetation stands which seem to contribute to the severe botulism outbreaks.
  - f. If water levels permit, a release of water from Medicine Lake in mid-September can be diverted into Homestead Lake to bring levels back up to 1935.0 elevation to provide adequate fall migrational habitat for waterfowl. This will require about 1,228 acre feet of water from Medicine Lake.
  - g. Water will again be released after fall migration is completed. By releasing water on November 1 and reducing the lake level to 1934.0 elevation, the carp population of the lake should be adequately reduced.
3. Lakes #10, #11, #12, Gaffney Lake, and Long Lake: Water levels for this series of water units are all dependent on spring run-off flows from Cottonwood, Sand, and Lake Creek. Mid-winter water levels vary from .40 to .95 feet below operational levels. Upstream impoundments will be filled first, then each impoundment below. If flows are adequate, water control structures will be opened rather than relying on spillways. This provides better flushing action in reducing accumulated salinity.

Specific objectives to be met in 1983:

- a. If spring run-off is adequate, all impoundments will be filled to operation levels as early as possible.
- b. If water reaches operational levels, breeding pair habitat for waterfowl will be maximized.
- c. At operational levels, constructed and natural nesting islands will remain secure and yet minimize erosion by wind and wave action.
- d. No water releases or drawdowns will be accomplished. By maintaining water levels as close to operational level as possible, brooding habitat will be optimum. After evaporation and loss to seepage, levels will remain adequate for fall migration.
- e. Lakes #10 and Gaffney have been historic sites for avian botulism.

This outbreak can be minimized or severity reduced by maintaining constant water levels. Rapid flooding of shallow areas following heavy summer rain storms seems to trigger outbreaks in these impoundments. Levels must remain constant following storms.

4. Katy's Lake and Deep Lake

These two natural sumps do not have outlets providing the option of flushing. These water bodies are the two most alkaline marshes on the refuge. Both marshes have water supplies provided by canals or water control structures.

Specific objectives for 1983:

- a. If spring water supplies are sufficient, both lakes will be filled to operational levels. This will maximize breeding pair and brooding habitat. These water levels produce good growth of aquatic vegetation.
- b. Katy's Lake has had a history of avian botulism. Rapid raises in mid-summer water levels must be prevented to alleviate losses.

Discharge (cfs x 1000)

Figure 1. Duration curves, of 600 gauge, for the period 1962-1973.

